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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Ninety-third Meeting
Montreal, 15-19 December 2023
Item 9(d) of the provisional agenda[1]

PROJECT PROPOSALS: INDIA

This document consists of the comments and recommendations of the Secretariat on the following project proposals:

Refrigeration (HFC)

- Conversion from R-407C and R-410A to HFC-32 in the manufacturing of light commercial air-conditioning packaged and ducted air-conditioning units at Voltas Limited — UNDP
- Demonstration/conversion from R-404A and R-407C to CO_2 transcritical heat pump technology in the food processing and cold storage refrigeration equipment manufacturing sector at Mech Air Industries — UNDP
- Conversion of the manufacturing of commercial refrigeration appliances at Rockwell Industries Limited from HFC-134a to propane (R-290) — UNDP

Energy efficiency

- Conversion of the manufacturing of commercial refrigeration appliances at Rockwell Industries Limited from HFC-134a to propane (R-290) (technical assistance to enhance the energy efficiency of the converted equipment) — UNDP
- Design and development of a pilot scale energy-efficient rotary compressor along with microchannel heat exchanger compatible with R-290 technology at Godrej & Boyce Mfg. Ltd., for use in manufacturing of room air conditioners — Germany

[1] UNEP/OzL.Pro/ExCom/93/1

PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECTS

INDIA

PROJECT TITLE	IMPLEMENTING AGENCY
Conversion from R-407C and R-410A to HFC-32 in the manufacturing line of light commercial packaged and ducted air-conditioning units at Voltas Limited, Vadodara	UNDP

NATIONAL CO-ORDINATING AGENCY	Ozone Cell, Ministry of Environment, Forest and Climate Change, Government of India

LATEST CONSUMPTION REPORTED FOR SUBSTANCES ADDRESSED BY THE PROJECT

A: ARTICLE-7 DATA (2022)

R-407C	444.55* mt	788,563 CO_2-eq tonnes
R-410A	-740.05 mt**	-1,544,848 CO_2-eq tonnes**

B: COUNTRY PROGRAMME SECTORAL DATA (2022)

R-407C	812.05 mt	1,440,453 CO_2-eq tonnes
R-410A	3,814.35 mt	7,962,406 CO_2-eq tonnes

HFC consumption remaining eligible for funding[2]	mt	n/a
	CO_2-eq tonnes	n/a

CURRENT YEAR BUSINESS PLAN ALLOCATIONS	**Enterprise**	**Funding (US $)**	**Phase-out (mt)**	
	Voltas	2,500,000	mt	n/a
			CO_2-eq tonnes	n/a

Particular	**Unit**	**R-407C**	**R-410A**
HFC used at enterprise	mt	30.29	4.63
	CO_2-eq tonnes	53,728	9,655
HFC to be phased out through this project	mt	30.29	4.63
	CO_2-eq tonnes	53,728	9,655
HFC alternatives to be phased in	**Unit**	**HFC-32**	
	mt	27.93	
	CO_2-eq tonnes	18,854	
Project duration (months)		24	
Initial amount requested (US $)		933,537	
Final project costs (US $)			
Incremental capital costs		244,500	
Contingency (10 % of equipment)		0	
Incremental operating costs*		178,061	
Total project cost		422,561	
Local ownership (%)		100	
Export component (%)		0	
Requested grant (US $)		422,561	
Cost-effectiveness	US $/kg	12.10	
	US $/$CO_2$-eq tonne	6.67	
Implementing agency support costs (US $)		29,579	
Total cost of project to Multilateral Fund (US $)		452,140	
Counterpart funding (Y/N)		Y	
Project monitoring milestones included (Y/N)		Y	

* The calculated consumption is lower than the use reported under the country's CP data report as the country also produces HFC-32, HFC-125, and HFC 134a; accordingly, use may reflect the manufacture of the blend from the constituent HFC components produced in the country.

** A negative calculated consumption is because the country exported more R-410A than it imported. The country also produces HFC-125 and HFC-32; accordingly, exports of R-410A may be associated with quantities of R-410A manufactured by blending the constituent HFC components produced in the country.

SECRETARIAT'S RECOMMENDATION	Individual consideration

[2]Not applicable: baseline for the country will be established in 2028, being in Group 2

PROJECT DESCRIPTION

1. On behalf of the Government of India, UNDP has submitted a proposal for a project to convert the manufacturing of light commercial packaged and ducted air-conditioning (AC) units at Voltas Limited (Voltas), Vadodara, from R-407C and R-410A to HFC-32, at a total cost of US $933,537, plus agency support costs of US $65,348, as originally submitted.

Project objective

2. The project will eliminate 30.29 metric tonnes (mt) of R-407C and 4.63 mt of R-410A (63,383 CO_2-equivalent tonnes (CO_2-eq tonnes)) consumed annually at Voltas by one line manufacturing packaged and ducted AC units of varying cooling capacities by converting to HFC-32.

HFC consumption and sector background

3. Space cooling is the largest segment of cooling demand in India, accounting for approximately 76 per cent of the total cooling demand in the country. Given limited penetration of space cooling equipment in the country, it has been estimated that space cooling demand will grow by a factor of 11 in the next 20 years.[3]

4. Packaged and ducted AC systems, including rooftop and indoor packaged units, are also known as unitary and light commercial systems in the commercial AC segment. These units are commonly used for AC of medium-sized commercial buildings. Packaged and ducted AC systems starting from 3 tonnes of refrigeration (TR) to 24 TR are manufactured in India using a single compressor for up to 10 TR cooling capacities and multiple compressors thereafter. Most of these units are manufactured and installed using R-407C and R-410A except some with HCFC-22. The manufacturing of such HCFC-22-based units is being converted to HFC-32 under stage III of the HCFC phase-out management plan (HPMP). Manufacturing of all equipment using HCFCs will cease by 1 January 2025, in line with the Ozone Depleting Substances (Regulation and Control) Rules, 2000 and its Amendments.

5. Under its 2022 country programme data report, India reported using 812.05 mt and 3,814.35 mt of R-407C and R-410A, respectively. Both substances are used to manufacture and service room air conditioners, packaged and ducted AC systems, and other equipment. While India submitted its 2021 and 2022 country programme (CP) data reports, the reports only provide the consumption by substance and blend but do not yet provide a breakdown of sectoral uses, including between manufacturing and servicing. At the 88th meeting, the Executive Committee approved enabling activities for HFC phase-down for the country; implementation of those activities will assist the Government in updating its 2021 and 2022 CP data by providing the sectoral breakdown of uses to the Secretariat by March 2024.

Enterprise background

6. Voltas is the oldest and largest AC equipment manufacturer in the country. Founded in 1954, the enterprise manufactures a broad range of refrigeration and AC equipment, including room air conditioners, packaged and ducted systems, variable refrigerant flow units, scroll chillers, and low-temperature refrigeration equipment for food processing and storage.

7. Voltas has manufacturing facilities in Uttarakhand and Gujarat (Waghodia, Vadodara,). The latter facilities do not manufacture room air conditioners but instead focus on packaged and ducted AC units, chillers (scroll, air-cooled, and water-cooled screw-chillers), and low-temperature refrigeration equipment using HFC-134a, R-407C, R-410A, R-404A, and HFC-32.

[3] India Cooling Action Plan (ICAP), 2019.

Enterprise-level HFC consumption

8. Voltas manufacturing facility at Waghodia, Vadodara has five manufacturing lines for commercial AC and refrigeration equipment. Two lines manufacture packaged and ducted systems, one of which used HCFC-22 and is being converted to HFC-32 under stage III of the HPMP, while the other manufactures R-407C and R-410A units and will be converted to HFC-32 under this project; two lines manufacture screw and centrifugal chillers using HCFC-134a; and one line manufactures low-temperature commercial chillers using R-404A. The enterprise also has a manufacturing line for heat exchangers (condenser and cooling coils).

9. A total of 4,753 units of packaged and ducted AC systems were manufactured in 2022 by the line to be converted, with an associated consumption of 30.29 mt of R-407C and 4.63 mt of R-410A. Twenty-one models are manufactured, 14 based on R-407C and the other seven based on R-410A. Consumption associated with the manufacturing at the line for the last four years is given in table 1:

Table 1: Consumption (kg) of R-407C and R-410A at the manufacturing line

HFC blend	2019	2020	2021	2022
R-407C	22,852	18,197	30,272	30,289
R-410A	5,577	7,155	7,936	4,625

Project description

10. The remaining line manufacturing packaged and ducted AC units with R-407C and R-410A will be converted to HFC-32 under the project. HFC-32 was selected after a comprehensive assessment of the relative merits of different technologies considering industry structure, application, safety, availability, and cost-effectiveness. In particular, the Government considered that given the refrigerant charge of the equipment, low-GWP refrigerants used for small capacity split systems are not feasible for this application; therefore, the Government considered that the only option for this application was to use a medium/lower-GWP refrigerant like HFC-32.

11. To ensure safety, the project proposes to implement the following changes: refrigerant charging stations designed for flammable refrigerants, leak testing equipment, and flame-proof areas with special monitoring systems; redesign of all models manufactured; change to compressors designed for HFC-32; training the workforce on handling and using flammable refrigerants; safe storage of finished products; safe storage of refrigerant cylinders; and safety audit following the conversion.

Project costs

12. Incremental capital costs (ICCs) were requested for product redesign, prototyping, and testing; refrigerant storage and distribution; assembly line modifications (including sheet metal processing modifications, charging machine and modifications to the charging station, vacuum pumps, pressure testing equipment and leak detectors); testing facility modification; plant fire safety and safety training; quality inspection; product certification; and technical assistance, as summarized in table 2.

Table 2. ICCs proposed for the conversion of a commercial air conditioning manufacturing line at Voltas

Description	Unit price (US $)	Quantity	Total Cost (US $)
Product redesign, prototyping and testing	2,500	21	52,500
Sheet metal processing	70,000	1	70,000
Charging area modifications	20,000	1	20,000
Pressure testing equipment (compressed air facility)	10,000	2	20,000
Explosion proof vacuum pumps (heavy duty)	7,500	2	15,000
Refrigerant charging equipment (station)	65,000	1	65,000
Industrial leak detectors	7,500	4	30,000

Description	Unit price (US $)	Quantity	Total Cost (US $)
Testing facility modification	60,000	1	60,000
Plant fire safety integrated system, standard operating procedures, and safety training	60,000	1	60,000
Technical assistance	90,000	1	90,000
Quality inspection, finishing and testing	10,000	1	10,000
Product certification	2,000	21	42,000
Contingencies	10%		53,450
Total ICC			**587,950**

13. Incremental operating costs (IOCs) of US $345,587 were calculated based on the difference in price of refrigerants and a 20 per cent reduction in charge,[4] change of electrical components (US $40/unit), and change of compressor (US $50/unit and US $20/unit for R-407C and R-410A, respectively), and the 2022 manufacturing of 581 R-407C packaged AC units, 3,331 R-407C ducted split AC units, and 841 R-410A ducted split AC units.

14. Based on the funding request of US $933,537, as submitted, the overall cost-effectiveness of the conversion from the use of R-407C and R-410A to HFC-32 at the line manufacturing light commercial AC systems (packaged and ducted) at Voltas, to be implemented over a period of 24 months, amounts to US $26.74/kg and is set to eliminate 30.29 mt of R-407C and 4.63 mt of R-410A (63,383 CO_2-eq tonnes). Table 3 presents a summary of project costs and expected outcomes, as submitted.

Table 3. Total costs requested for the conversion of one commercial air conditioning-manufacturing line at Voltas

Item		Cost in US $
ICCs		587,950
IOCs		345,587
Total requested		**933,537**
HFC phase-out from the funded line (mt)		34.914
Cost-effectiveness	(US $/kg)	26.74
	(US $/$CO_2$-eq tonne)	21.00*

* As submitted, the calculated cost-effectiveness took into account that 27.93 mt of HFC-32 would be phased in. Excluding that phase-in results in a cost effectiveness of US $14.73/$CO_2$-eq tonne.

SECRETARIAT'S COMMENTS AND RECOMMENDATION

COMMENTS

Relation to stage I of the Kigali HFC implementation plan and sustainability of HFC reductions

15. The project was submitted in line with decision 87/50(e) in advance of stage I of a Kigali HFC implementation plan (KIP). The Secretariat noted that project preparation funding for the stage I of the country's KIP was expected to be submitted in 2024 and the stage I in 2025 or 2026 and sought to better understand the relation of the project with stage I of the country's KIP.

16. UNDP explained that pursuant to India's ratification of the Kigali Amendment in September 2021, and with the support of the enabling activities approved at the 88th meeting, the Government was developing a national strategy for HFC phase-down in consultation with concerned stakeholders. Accordingly, the Government was not in a position at this time to determine whether the remaining enterprises manufacturing R-407C-based and R-410A-based light commercial AC units would convert their lines under the stage I of the KIP. While the relationship between the project and activities that would be undertaken under the KIP

[4] The price of R-407C and HFC-32 was US $6.50/kg and R-410A was US $9/kg. Prices are not available in the country's CP data report.

could not yet be determined, UNDP emphasized that the project would build confidence in the viability of low-GWP technologies and send an early signal to the market of the upcoming HFC phase-down.

17. Notwithstanding that the nexus of the conversion at Voltas to the country's KIP was not yet clear and the consumption of the line was small relative to that of the country, the Secretariat noted that the conversion addresses a sector that was growing rapidly; that such growth would likely be to high-GWP HFCs absent interventions; and that early action would meaningfully contribute to the country's phase-down. Given the conversion of the manufacturing line at Voltas under stage III of the HPMP to the same technology, and the broad uptake of HFC-32 technology in AC applications in the region, the Secretariat considered the risk to the sustainability of the conversion was low.

Deduction of HFC reductions from the starting point

18. The phase-out of 63,383 CO_2-eq tonnes (30.29 mt of HFC-407C and 4.63 mt of R-410A) resulting from the approval of the present project will be deducted from the country's HFC consumption eligible for funding identified in the KIP. Accordingly, once the starting point for sustained aggregate reduction in HFC consumption is established, the reductions proposed by this project will need to be deducted in accordance with the methodology agreed under the HFC cost guidelines (currently under discussion).

Technical and cost related issues

19. The Secretariat and UNDP discussed in detail each of the items required for the conversion at Voltas. In particular, the Secretariat noted that the enterprise had been funded under stage III of the HPMP to convert to the same alternative at another line manufacturing the same type of equipment at the same facility. On that basis, the Secretariat proposed adjustments to several of the requested costs, including for product design, prototyping and testing, product certification, and technical assistance; and to harmonize costs with those agreed under stage III, including for sheet metal processing, charging area modifications, and the charging machine. Noting that R-410A and HFC-32 have comparable operating pressures, and that the baseline pressure testing equipment could already achieve the necessary pressure but was likely past its useful lifetime, the enterprise agreed to co-finance that equipment. In addition, the enterprise agreed, on an exceptional basis, not to request contingencies.

20. Under stage III of the HPMP, no funding had been requested to modify the performance testing facility. UNDP explained that under stage III the enterprise had planned to outsource equipment testing; that such an approach would no longer be viable with the conversion of the second line; and that such outsourcing would effectively increase IOCs. The Secretariat noted that under other projects, funding had been provided to upgrade testing laboratories to enable the safe testing of equipment based on flammable alternatives, and that several projects that included such funding were being recommended for approval to the present meeting. Consistent with those projects and noting the conversion of this second manufacturing line at the enterprise would require further investments for plant fire safety, the costs associated with modifying the testing facility and plant fire safety were agreed at US $75,000, resulting in agreed ICCs of US $244,500.

21. The Secretariat noted that while IOCs had been agreed at US $3.80/kg for the conversion under stage III of the HPMP, there was uncertainty in their determination, which depended on the relative price of refrigerants, compressors, and change of electrical components, which could change with time. In view of that uncertainty, IOCs were agreed at US $5.10/kg, a mid-point between the IOCs agreed under stage III and the US $6.30/kg for the AC sector agreed for the HCFC phase-out under decision 74/50. The agreed costs of the conversion of the manufacturing line of light commercial air conditioning systems to HFC-32 at Voltas Limited are shown in Table 4.

Table 4. Agreed costs of the conversion to HFC-32 at Voltas

Description		**Proposed Cost (US $)**	**Agreed cost (US $)**
Product redesign, prototyping and testing		52,500	31,500
Sheet metal processing		70,000	15,000
Charging area modifications		20,000	10,000
Pressure testing equipment (compressed air facility)		20,000	0
Explosion proof vacuum pumps (heavy duty)		15,000	10,000
Refrigerant charging equipment (station)		65,000	37,000
Industrial leak detectors		30,000	30,000
Testing facility modification, plant fire safety, and training		120,000	75,000
Technical assistance		90,000	5,000
Quality inspection, finishing and testing		10,000	10,000
Product certification		42,000	21,000
Contingencies		53,450	0
Total ICC		**587,950**	**244,500**
IOCs		345,587	178,061
Total Project Costs		**933,537**	**422,561**
HFC consumption phase-out (mt)		34.91	34.91
HFC to be phased out: R-407C (mt)		30.29	30.29
HFC to be phased out: R-410A (mt)		4.62	4.62
HFC consumption phase-out (CO_2-eq tonne)		63,383	63,383
Cost Effectiveness	(US $/kg)	26.74	12.10
	(US $/$CO_2$-eq tonne)	14.73	6.67

22. The Secretariat notes that in the absence of the cost guidelines for HFC phase-out, this project has been reviewed on a case-by-case basis. Based on the information available at the time of review, the Secretariat considers that the agreed costs are the best estimate of the overall incremental costs of the conversion; however, these estimates might change, according to the specific characteristics of participating enterprises, as more information becomes available. In particular, the Secretariat notes that because of the assistance provided to the enterprise under stage III, the costs for the conversion are lower than might be expected for other enterprises that manufacture HFC-based light commercial AC equipment that had not received such assistance and, therefore, that the agreed costs should not constitute a precedent.

Project climate impact

23. The annual direct emission benefits from the project may be estimated based on the elimination of the R-407C and R-410A consumption of the manufacturing line (63,383 CO_2-eq tonnes) and taking into account that 27.93 mt (18,854 CO_2-eq tonnes) of HFC-32 will be phased in, resulting in annual reduction of 44,529 CO_2-eq tonnes. The Secretariat has not estimated the climate benefits that may be accrued through improvements in the energy efficiency of the equipment manufactured on the converted line.

2023–2025 business plan

24. This project is included in the 2023–2025 business plan of the Multilateral Fund at US $2,500,000, including agency support costs. The agreed costs are US $2,039,408 below the value in the business plan.

RECOMMENDATION

25. The Executive Committee may wish to consider:

(a) Approving the project proposal for the conversion of light commercial air-conditioning systems manufacturing at Voltas Limited from the use of R-407C and R-410A to HFC-32 in the amount of US $422,561, plus agency support costs of US $29,579 for UNDP, on the understanding:

(i) That 63,383 CO_2-eq tonnes of HFCs (30.29 mt of R-407C and 4.63 mt of R-410A) would be deducted from the starting point for sustained aggregate reductions in HFC consumption once it had been established, and that this deduction would be undertaken in accordance with the methodology agreed under the HFC cost guidelines currently under discussion;

(ii) That the present project would be integrated into stage I of the Kigali HFC implementation plan for India, once the plan had been fully formulated for submission for consideration by the Executive Committee; and

(iii) That the level of costs approved would not constitute a precedent for future HFC individual investment project proposals.

PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECTS

INDIA

PROJECT TITLE	IMPLEMENTING AGENCY
Demonstration/conversion from R-404A and R-407C to CO_2 transcritical heat pump technology in the food processing and cold storage refrigeration equipment manufacturing sector at Mech Air Industries, Vadodara	UNDP

NATIONAL COORDINATING AGENCY	Ozone Cell, Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India

LATEST CONSUMPTION REPORTED FOR SUBSTANCES ADDRESSED BY THE PROJECT

A: ARTICLE-7 DATA (2022)

R-404A	1,038.27 mt	4,071,644 CO_2-eq tonnes
R-407C	444.55* mt	788,563 CO_2-eq tonnes

B: COUNTRY PROGRAMME SECTORAL DATA (2022)

R-404A	1,038.27 mt	4,071,644 CO_2-eq tonnes
R-407C	812.05 mt	1,440,453 CO_2-eq tonnes

HFC consumption remaining eligible for funding[5]	mt	n/a
	CO_2-eq tonnes	n/a

CURRENT YEAR BUSINESS PLAN ALLOCATIONS	**Enterprise**	**Funding (US $)**	**Phase-out (mt)**	
	Mech Air	2,500,000	mt	n/a
			CO_2-eq tonnes	n/a

Particular	**Unit**	**R-404A**	**R-407C**
HFC used at enterprise	mt	1.20	0.54
	CO_2-eq tonnes	4,706	956
HFC to be phased out through this project	mt	1.20	0.54
	CO_2-eq tonnes	4,706	956
HFC alternatives to be phased in	**Unit**	**CO_2**	
	mt	1.39	
	CO_2-eq tonnes	1.39	
Project duration (months)		24	
Initial amount requested (US $)		322,452	
Final project costs (US $)			
Incremental capital costs		222,500	
Contingency (10 % of equipment)		22,250	
Incremental operating costs*		77,702	
Total project cost		322,452	
Local ownership (%)		100	
Export component (%)		0	
Requested grant (US $)		322,452	
Cost-effectiveness	US $/kg	127.85	
	US $/$CO_2$-eq tonne	39.30	
Implementing agency support costs (US $)		22,752	
Total cost of project to Multilateral Fund (US $)		345,024	
Counterpart funding (Y/N)		Y	
Project monitoring milestones included (Y/N)		Y	

* The calculated consumption is lower than the use reported under the country's CP data report as the country also produces HFC-32, HFC-125, and HFC 134a; accordingly, use may reflect the manufacture of the blend from the constituent HFC components produced in the country.

SECRETARIAT'S RECOMMENDATION	Individual consideration

[5] Not applicable: baseline for the country will be established in 2028, being in Group 2

PROJECT DESCRIPTION

26. On behalf of the Government of India, UNDP has submitted a proposal for a project to convert the manufacturing of food processing and cold storage refrigeration equipment at Mech Air Industries, Vadodara (Mech Air), from R-404A and R-407C to transcritical CO_2 heat pump technology at a total cost of US $322,452, plus agency support costs of US $22,572, as originally submitted.

Project objective

27. The project will eliminate 1.20 metric tonnes (mt) of R-404A and 0.54 mt of R-407C (5,661 CO_2-eq tonnes) consumed annually by one line manufacturing food processing and cold storage refrigeration equipment at Mech Air, by converting to transcritical CO_2 heat pump technology.

28. The project also aims to demonstrate the technical feasibility of transcritical CO_2 heat pump technology for simultaneous cooling and heating by food processing equipment in hot and humid climatic conditions.

HFC consumption and sector background

29. Under its 2022 country programme data report, India reported consumption of R-404A and R-407C at 1,038.27 mt (4,071,644 CO_2-eq tonnes) and 812.05 mt (1,440,453 CO_2-eq tonnes), respectively.

30. Refrigeration related to food processing and cold chain represents a small portion of the aggregated cooling demand in the country but is expected to rapidly grow due to urbanization, economic development, and the current low penetration of cooling. Moreover, the recognition of the importance of food processing refrigeration equipment and the role of the cold chain in reducing perishable food spoilage contributes to the growing demand for cooling equipment, in particular, food processing units, pack houses, reefer transport and ripening chambers, required to create an uninterrupted cold chain. Current refrigerant consumption in this sector is estimated at 3,000 mt but was expected to grow to 9,000 mt by 2038.[6]

31. Ammonia is the main refrigerant used in industrial refrigeration, but HFCs (e.g., R-404A, R-407C and R-507A) are used in some equipment due to specific conditions and restrictions in the use of ammonia, as well as an alternative to old HCFC-22 and R-502-based equipment. Manufacturers are now considering transitioning to some low-GWP refrigerants like CO_2 and hydrocarbons or low-GWP HFC/HFO blends as market acceptance is growing due to environmental considerations.

Enterprise background

32. Mech Air is a family-owned enterprise established in June 1998 that manufactures refrigeration products including cold storage, blast freezers, and ripening chamber refrigeration equipment. Mech Air designs and develops customized refrigeration equipment for these applications and implements turnkey projects for post-harvest management, cold-chain management, food processing and other applications. The enterprise also manufactures the heat exchangers needed for the equipment produced.

Enterprise-level HFC consumption

33. In 2002, Mech Air Industries started manufacturing refrigeration equipment for cold storage, blast freezers, and ripening chambers using R-404A and R-407C. The number of units produced in 2022 and the consumption of R-404A and R-407C at the enterprise for 2020-2022 is shown in table 1.

[6] ICAP 2019

Table 1. HFC consumption at Mech Air

Applications	Refrigerant	Production 2022 (units)	Refrigerant charge (kg/unit)	Consumption (kg)		
				2020	2021	2022
Cold Storages	R-404A	150	5	750	730	750
Blast Freezers	R-404A	25	18	450	420	450
Ripening Chambers	R-407C	90	6	540	525	540
On-site charging (Usage)	R-404A			400	900	1,500

Project description

34. Mech Air will convert the manufacturing line of food processing equipment, cold storage, blast freezers, and ripening units from R-404A and R-407C to CO_2-based technology.

35. Most of the equipment manufactured by Mech Air is customized based on the application and operating temperature and humidity requirements. Transcritical CO_2 based technology in heat-pump mode has been selected for the conversion as it is an energy-efficient low-GWP alternative that could provide cooling and hot water, required in dairy, marine, and food processing industries.

36. Conversion to a high-pressure refrigerant like CO_2 requires changes in the product, manufacturing processes, equipment, and testing facility. The modifications to be made in the product and manufacturing lines at Mech Air include the redesign of all the products manufactured; modifications in sheet metal processing and heat exchanger manufacturing (including replacement of fin punch dies, tube bender, hydraulic tube expander and brazing equipment); modification to the pressure testing equipment; replacement of the refrigerant charging machine and vacuum pumps; changes to the performance testing facility; technical assistance; training of personnel; trials and testing of products; and product safety.

Project costs

37. The total cost of converting the manufacturing line at Mech Air from R-404A and R-407C to trans critical CO_2-based heat pump technology is US $322,452 consisting of US $244,750 for incremental capital costs (ICCs) and US $77,702 for incremental operating costs (IOCs).

38. ICCs are calculated based on the modifications described in paragraph 36. IOCs are calculated based on incremental costs related to change of compressor (US $250 per unit for cold storage and ripening chamber, and US $400 for blast freezers); change of electrical components and controls (US $70 per unit for cold storage and ripening chamber, and US $115 per unit for blast freezers), and savings related to the change of refrigerant (US $36.78 per unit for cold storage, US $133.41 per unit for blast freezers, and US $34.96 per unit for ripening chamber). Total IOCs per cold storage unit is US $283.22, per blast freezer is U $382.59 and per ripening chamber is US $285.04.

39. Based on the funding request, the overall cost-effectiveness of the conversion from the use of R-404A and R-407C to transcritical CO_2 heat pump technology at one line manufacturing at Mech Air, implemented over a period of 24 months, amounts to US $127.85/kg (US $39.30/$CO_2$ eq tonnes) and is set to eliminate 1.20 mt of R-404A and 0.54 mt of R-407C (5,661 CO_2-eq tonnes). Table 2 presents a summary of project incremental costs, as submitted.

Table 2. ICCs proposed for the conversion of Mech Air

Description		Unit price (US $)	Quantity	Total Cost (US $)
Product redesign, prototyping and testing		10,000	3	30,000
Sheet metal processing		15,000	1	15,000
Fin punching dies7.5		5,000	3	15,000
Charging area modifications		5,000	1	5,000
Pressure testing equipment (compressed air facility)		10,000	1	10,000
Vacuum pumps (heavy duty)		5,000	1	5,000
Refrigerant charging equipment		7,500	1	7,500
Industrial leak detectors		5,000	1	5,000
Testing facility modification		60,000	1	60,000
Safety equipment, SOPs and safety training		10,000	1	10,000
Technical assistance		30,000	1	30,000
Quality inspection finishing and testing modifications		10,000	1	10,000
Product certification		5,000	4	20,000
Sub-total ICC				*222,500*
Contingencies		10%		22,200
Total ICC				*244,750*
Total IOC				*77,702*
Total incremental cost				**322,452**
Co-financing				100,000
Funds requested to the Multilateral Fund				**222,452**
Cost-effectiveness	US $/kg			127.85
	US $/$CO_2$-eq tonnes			39.30

SECRETARIAT'S COMMENTS AND RECOMMENDATION

COMMENTS

Relation to stage I of the Kigali HFC implementation plan and sustainability of HFC reductions

40. The Mech Air project proposal was submitted in line with decision 87/50(e) in advance of stage I of the KIP. The Secretariat noted that project preparation funding for stage I of the country's KIP was expected to be submitted in 2024 and stage I in 2025 or 2026 and sought to better understand the relation and relevance of the project with stage I of the country's KIP and the overarching strategy of the country that will determine whether these applications will be addressed in stage I of the KIP as part of a more comprehensive sectoral or subsectoral approach.

41. UNDP informed that from the preliminary data obtained it has been noted that food processing and cold storage application face challenges in finding suitable low-GWP refrigerant options that are not flammable or toxic (from the fluorocarbon refrigerants) except some blends that are yet to be commercialized and whose costs may also be very high. Hence, natural refrigerants like CO_2 may be the best option for these applications. While Mech Air's HFC consumption is small, it also manufactures a broad range of non-HFC-based equipment and had considerable technical expertise and has demonstrated greater interest and is ready to commit to adopt this technology. UNDP expects that this project would help signal that low GWP natural refrigerants are feasible alternatives to accelerate phase-down of high-GWP R-404A in this sector.

42. UNDP also explained that the technology proposed is energy efficient and provides both cooling and heating, which are needed in the food processing industry, and that sustainability would not be an issue as the enterprise, even though its consumption was small, has the technical capacity to adopt the technology,

as was determined by a third-party during a site verification. Several rounds of discussion with the enterprise led to the conclusion that the proposed conversion could be successfully completed and sustained. Furthermore, Mech Air's clients profile allows the placement of the technology in a sustainable way as the investment payback time can be reduced with the widespread of the technology. UNDP considered that HFC phase-down will take place (even though the quantity is small) fitting the criteria of decision 87/50(e). Accordingly, the Government of India believes that the project has merit for both conversion of the manufacturing line in the enterprise, and high replicability and scale-up potential as part of the future sector plans that could be included in KIP stage I.

43. Upon review of the information provided, while the Secretariat acknowledged with appreciation the formulation of this project, the Secretariat noted the following issues:

(a) The consumption to be phased out (under 2 mt) constitutes an insignificant proportion of the estimated 3,000 mt of refrigerants used in the sector. The conversion of this enterprise has a poor cost-effectiveness (US $127.85/kg) and is not expected to generate a significant impact or substantially influence the technology uptake of the sector;

(b) With estimated IOCs at a level of US $44.66/kg, it would be very disadvantageous for the enterprise to compete with other enterprises in the sector that could continue to manufacture similar equipment based on HFCs for at least another five to six years (assuming they were converted as part of stage I of the KIP). This could place the enterprise's competitiveness at risk or make the conversion unsustainable; and

(c) Given the limited impact of this conversion and the fact that the overarching strategy for the country is still to be developed (i.e., it has not been determined whether this type of application would be prioritized) it is unclear how this project could contribute to stage I of the KIP.

44. Based on the above considerations, the Secretariat considers that the potential benefits of this project might be more clear once the overarching strategy is more advanced and it is determined whether these applications would be addressed in stage I of the KIP, and as part of a more comprehensive sectoral or subsectoral approach that would allow better cost-effectiveness, larger influence in the adoption of the technology by other enterprises in the sectors, and better sustainability in the adoption of the technology.

45. The Executive Committee decided, in the absence of the cost guidelines for HFC phase-down, to inter alia consider HFC individual investment projects on a case-by-case basis, and without setting a precedent for the cost guidelines or any future HFC individual investment projects and stage I of KIPs (decision 91/38(a)). The Secretariat is presenting the project for the Executive Committee's consideration in line with that decision.

RECOMMENDATION

46. The Executive Committee may wish to consider the project proposal for the demonstration/conversion of the manufacturing of food processing and cold storage refrigeration equipment at Mech Air Industries from the use of R-404A and R-407C as the refrigerant to CO_2 transcritical heat pump technology in light of the information contained in document UNEP/OzL.Pro/ExCom/93/60.

PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECTS

INDIA

PROJECT TITLE	IMPLEMENTING AGENCY
Conversion of the manufacturing of commercial refrigeration appliances at Rockwell Industries Limited, Hyderabad, from the use of HFC-134a to propane (R-290) as a refrigerant	UNDP

NATIONAL CO-ORDINATING AGENCY	Ozone Cell, Ministry of Environment, Forest and Climate Change, Government of India

LATEST REPORTED CONSUMPTION DATA FOR HFCS ADDRESSED IN THE PROJECT

A: ARTICLE-7 DATA (2022)

HFC-134a	17,740.47 mt	25,368,871 CO_2-eq tonnes

B: COUNTRY PROGRAMME SECTORAL DATA (2022)

HFC-134a	17,740.47 mt	25,368,871 CO_2-eq tonnes

HFC consumption remaining eligible for funding[7]	mt	n/a
	CO_2-eq tonnes	n/a

CURRENT YEAR BUSINESS PLAN ALLOCATIONS	**Enterprise**	**Funding US $**	**Phase-out**	
	Rockwell	2,500,000	mt	21.91
			CO_2-eq tonnes	31,328

Particular	**Unit**	**HFC-134a**
HFC used at enterprise	mt	21.91
	CO_2-eq tonnes	31,328
HFC to be phased out through this project	mt	21.91
	CO_2-eq tonnes	31,328
HFC alternatives to be phased in	**Unit**	**R-290**
	mt	15.33
	CO_2-eq tonnes	46
Project duration (months)		24
Initial amount requested (US $)		1,385,201
Final project costs (US $)		
Incremental capital costs		324,300
Contingency (10 % of equipment)		16,215
Incremental operating costs		83,250
Total project cost		423,765
Local ownership (%)		100
Export component to non-Article 5 countries (%)		0
Requested grant (US $)		423,765
Cost-effectiveness	US $/kg	19.34
	US $/$CO_2$-eq tonne	13.55
Implementing agency support costs (US $)		29,664
Total cost of project to Multilateral Fund (US $)		453,429
Counterpart funding (Y/N)		Y
Project monitoring milestones included (Y/N)		Y

SECRETARIAT'S RECOMMENDATION	Individual consideration

[7]Not applicable: baseline for the country will be established in 2028, being in Group 2

PROJECT DESCRIPTION

47. On behalf of the Government of India, UNDP has submitted a proposal for a project to convert the manufacturing of commercial refrigeration appliances at Rockwell Industries Limited (Rockwell), Hyderabad, from the use of HFC-134a to propane (R-290) as a refrigerant, at a total cost of US $1,385,201, plus agency support costs of US $96,964, as originally submitted.

Project objective

48. The project will eliminate 21.91 metric tonnes (mt) (31,328 CO_2-eq tonnes) of HFC-134a consumed annually by two lines manufacturing commercial refrigeration appliances at Rockwell, by converting to R-290.

49. The project proposal also included a funding request for technical assistance at a cost of US $172,500, plus agency support costs, for an energy efficiency pilot component to achieve energy-efficiency improvements, as presented and discussed in paragraphs 72 to 84 of the present document.

HFC consumption and sector background

50. In 2022, India reported under Article 7 consumption of HFC-134a of 17,740.47 mt (25,368,871 CO_2-eq tonnes).

51. The commercial refrigeration sector has been experiencing rapid growth in India due to climatic conditions and the expansion of the cold chain as response to the growing needs for the preservation of perishable food and pharmaceutical products. Furthermore, the growing urbanization in India has significantly increased the manufacturing base and use of horizontal and vertical medium- and low-temperature display cabinets, freezers, and vending machines in convenience shops, restaurants, hotels, and public places throughout the country.

52. Currently, commercial refrigeration equipment manufacturing is mainly with HFC-134a (as a replacement of CFC-12-based technology), followed by R-404A (in larger systems to some extent as a replacement of HCFC-22-based technology). Manufacturers, particularly for stand-alone units such as commercial displays, deep and chest freezers and coolers, are keen to replace HFC-134a with low-GWP refrigerants due to environmental considerations. The use of R-290 is increasing as a well-accepted technology.

Enterprise background

53. Rockwell, founded in 1986, is a leading commercial refrigeration appliances manufacturer in India. It manufactures a large range of commercial refrigeration products including deep freezers, display cabinets, and bottle coolers/chillers of varying ranges of operating temperatures from minus 18 and plus two degrees Celsius.

54. The enterprise has two manufacturing lines housed in two separate buildings at the same premises in Hyderabad, India, with an annual manufacturing capacity of 400,000 units, including customized refrigeration solutions for clients with specific requirements. Currently, it manufactures around 100,000 units/year.

Enterprise-level HFC consumption

55. Rockwell manufactures several models of self-contained commercial refrigeration appliances with three refrigerant charge sizes (190g, 270g and 300g), as summarized in table 1.

Table 1. Products manufactured by Rockwell

Product manufactured	Number of models	Units manufactured (2022-2023)	HFC-134a used per unit (kg)
Manufacturing line 1			
Deep freezer - Hard top models	5	47,320	0.190
Deep freezer - Display models	4	13,350	0.190
Bottle cooler	2	16,100	0.300
Total	**11**	**76,770**	
Manufacturing line 2			
Deep freezer - Hard top models	5	14,800	0.190
Deep freezer - Display models	4	480	0.190
Deep freezer - Eutectic models	4	1,250	0.270
Bottle cooler	2	7,700	0.300
Total	**15**	**24,230**	

56. The consumption of HFC-134a by Rockwell for the last three years is presented in table 2.

Table 2. Consumption of HFC-134a at Rockwell (2020-2022)

Manufacturing lines	Initiation year	Refrigerant used	Consumption (kg)		
			2020	2021	2022
Line 1	2003	HFC-134a	9,148	13,000	16,357
Line 2	2014	HFC-134a	3,742	4,201	5,551
Total annual consumption			**12,890**	**17,201**	**21,908**

Project description

57. The two lines manufacturing commercial refrigeration products with HFC-134a will be converted to R-290 under the project.

58. R-290 was selected from among the currently available replacements for HFC-based capacity, including CO_2, HCs, HFOs and blends, due to its zero-ODP and low-GWP, excellent thermodynamic and transport properties, better performance than HFC-134a once optimized, no compatibility issues with materials currently used with HFC-134a, and compatibility with most oils including mineral, alkyl-benzene oil and polyol ester oil.

59. Because of its flammability, the conversion to R-290 requires substantial changes in the manufacturing facilities, processes and equipment, including redesign of all the models manufactured; change of the refrigerant charging units; modification to some manufacturing areas to include ventilation, leak testing equipment and flame-proof areas with monitoring systems; training of the workforce; safe storage of finished products; safe storage of refrigerant cylinders in well ventilator area fitted with hydrocarbon sensors, alarms, fire extinguishers and hydrant system; and safety audit. Modifications to the product include the use of spark-free/solid-state electrical components and fittings like the thermostat, fan motor, and lighting apart from the specially designed compressor for R-290.

Project costs

60. Incremental capital costs (ICCs) were requested in the amount of US $708,400 for model redesign, prototyping and testing, pressure testing, explosion-proof vacuum pumps, refrigerant charging machine, leak detection system, storage, handling and distribution, technical assistance, training of personnel, trial and testing of products, and contingencies, as summarized in table 3.

Table 3. ICCs proposed for the conversion of two commercial refrigeration lines at Rockwell

Description	Unit price (USD)	Quantity	Total Cost (USD)
Redesign, prototyping and testing	2,000	15	30,000
Pressure testing equipment - high pressure air compressor	10,000	2	20,000
Explosion proof industrial vacuum pump	3,500	40	140,000
Refrigerant charging machine (heavy duty, automatic)	37,000	2	74,000
Helium leak detector	65,000	2	130,000
Industrial leak detectors (fixed lines)	7,500	4	30,000
Ultrasonic welding machine	25,000	2	50,000
Evaporator leak testing (H_2N_2)	10,000	2	20,000
Safety system (manufacturing, storage area and finished products storage area)	25,000	2	50,000
Refrigerant distribution system (booster pumps for refrigerant distribution)	10,000	2	20,000
Technical assistance	20,000	1	20,000
Safety audit by third party (TUV)	20,000	1	20,000
Safety Training for plant operators	10,000	1	10,000
Production trials and testing	2,000	15	30,000
Sub-total ICC			*644,000*
Contingencies	10%		64,400
Total ICC			**708,400**

61. Incremental operating costs (IOCs) requested in the amount of $676,801 were calculated based on changes in the price and quantity of refrigerants, change of electrical components, and change of compressor applied to the three sizes of products. The estimated IOCs per unit was US $4.50, US $5.50 and US $7.50 per for models with 190g, 270g and 330g of refrigerant charge, respectively.

62. The total cost of converting the two manufacturing lines at Rockwell from HFC-134a to R-290 implemented over a period of 24 months, amounts to US $1,385,201 to phase out 21.91 mt of HFC-134a (31,328 CO_2-eq tonnes), as summarized in table 4.

Table 4. Total costs requested for the conversion of two commercial refrigeration-manufacturing lines at Rockwell

Item		Cost in US $
ICCs		708,400
IOCs		676,801
Total requested		***1,385,201**
HFC phase-out from the funded line (mt)		21.91
Cost-effectiveness	(US $/kg)	63.23
	(US $/$CO_2$-eq tonne)	44.22

* This costs do not include the pilot project on energy efficiency, discussed in paragraphs 72 to 84 of the present document.

SECRETARIAT'S COMMENTS AND RECOMMENDATION

COMMENTS

Relation to stage I of the Kigali HFC implementation plan and sustainability of HFC reductions

63. The Rockwell project proposal was submitted in line with decision 87/50(e) in advance of stage I of the KIP. The Secretariat noted that project preparation funding for stage I of the country's KIP was expected to be submitted in 2024 and stage I in 2025 or 2026 and sought to better understand the relation and relevance of the project with stage I of the country's KIP.

64. UNDP explained that manufacturers of stand-alone units such as commercial displays, deep and chest freezers and coolers were keen to move away from HFC-134a and use low-GWP refrigerants, and that R-290 was well accepted in the market and its use was growing due to environmental considerations. The conversion at Rockwell aimed to initiate conversion activities for minimizing the penetration of high-GWP HFC refrigerants in India. The Secretariat noted that while the consumption at the enterprise was small relative to that in the sector, the use of R-290 for stand-alone commercial refrigeration applications was well established and, therefore, considered the risk to the sustainability of the conversion to be small.

Deduction of HFC reductions from the starting point

65. The phase-out of 31,328 CO_2-eq tonnes (21.91 mt) of HFC-134a resulting from the approval of the present project will count against the consumption eligible for funding identified in the KIP. Accordingly, once the starting point for sustained aggregate reduction in HFC consumption is established, the reductions proposed by this project will need to be deducted in accordance with the methodology agreed under the HFC cost guidelines (currently under discussion).

Technical and cost related issues

66. The Secretariat and UNDP discussed in detail each of the items required for the conversion at Rockwell and agreed to a number of adjustments. The costs related to the pressure testing equipment were removed as the baseline equipment for the current HFC-134a-based manufacturing can be applied to R-290-based technology; the 40 explosion proof industrial vacuum pump requested were reduced to two units for the recovery station and US $20,000 was agreed for civil construction of the vacuum pump area to improve safety; the unit costs for safety system and refrigerant distribution system were adjusted to harmonize in line with precedent similar conversions; and the safety system for the storage area was rationalized as the storage area could be share by the two manufacturing lines. Given the range of refrigerant charge in the baseline equipment manufactured, a helium leak detector was not considered incremental; however, it was recognized that evaporator leak testing with H_2N_2 allowed for a more sensitive determination of leaks, which would contribute both to the safety of R-290-based equipment and its energy-efficient operation; therefore, it was agreed to split the costs associated with the evaporator testing between the enterprise and the Multilateral Fund.

67. Taking into consideration prototypes testing is also partially funded under the energy efficiency pilot component, production trials and testing were rationalized from $2,000 to $1,500 per unit, for the 15 models. Similarly, technical assistance and production trials and testing were rationalized to US $7,500 and US $15,000 given the similar activities undertaken under the energy efficiency pilot project. Contingencies were also exceptionally agreed by the enterprise to be adjusted from 10 to 5 per cent. IOCs were agreed, on an exceptional basis, at US $3.80/kg, resulting in total IOCs of US $83,250. The total ICC is adjusted to US $423,765 as shown in table 4.

Table 4 Proposed and agreed ICCs and IOCs for the conversion of two commercial refrigeration lines at Rockwell

Description	Proposed Cost (US $)	Agreed cost (US $)
Redesign, prototyping and testing	30,000	22,500
Pressure testing equipment - high pressure air compressor	20,000	0
Explosion proof industrial vacuum pump	140,000	7,000
Civil construction (adaptation) of vacuum pump area (anti-explosion features)	0	20,000
Refrigerant charging machine (heavy duty, automatic)	74,000	74,000
Helium leak detector	130,000	0
Industrial leak detectors (fixed lines)	30,000	30,000
Ultrasonic welding machine (heavy duty)	50,000	50,000

Description		Proposed Cost (US $)	Agreed cost (US $)
Evaporator leak testing (H_2N_2)		20,000	12,000
Safety System (manufacturing, storage area and finished products storage area)		50,000	40,000
Refrigerant distribution system (booster pumps for refrigerant distribution)		20,000	16,300
Technical assistance		20,000	7,500
Safety audit (TUV)		20,000	20,000
Safety training for plant operators		10,000	10,000
Production trials and testing		30,000	15,000
Sub-total – ICC		644,000	324,300
Contingencies		64,400	16,215
Total ICC		*708,400*	*340,515*
IOCs		*676,801*	*83,250*
Total Project costs		**1,385,201**	**423,765**
HFC consumption phase-out (mt)		21.91	21.91
HFC consumption phase-out (CO_2-eq tonnes)		31,328	31,328
Cost Effectiveness	(US $/kg)	62.23	19.34
	(US $/ CO_2-eq tonne)	44.22	13.53

68. The Secretariat that in the absence of the cost guidelines for HFC phase-out, this project has been reviewed on a case-by-case basis. Based on the information available at the time of review, the Secretariat considers that the agreed costs are the best estimate of the overall incremental costs of the conversion; however, these estimates might change, according to the specific characteristics of participating enterprises, as more information becomes available. In particular, the Secretariat notes that some of the costs (i.e., related to redesign, prototyping and testing, technical assistance, and production trials and testing) were reduced based on the joint implementation of the pilot energy efficiency project. Other enterprises that did not benefit from such joint implementation may face a higher cost for those items. The Secretariat therefore considers that approval of the project at the levels proposed above would not constitute a precedent.

Project climate impact

69. The annual direct emission benefits from the project may be estimated based on the elimination of the HFC-134a consumption of the manufacturing lines (31,328 CO_2-eq tonnes) and taking into account that 15.33 mt (46 CO_2-eq tonnes) of R-290 will be phased in, resulting in annual reduction of 31,282 CO_2-eq tonnes. The Secretariat has not estimated the climate benefits that may be accrued through improvements in the energy efficiency of the equipment manufactured on the converted line.

2023–2025 business plan

70. This project is included in the 2023–2025 business plan of the Multilateral Fund at US $2,500,000, including agency support costs. The total requested value of US $453,429, including agency support costs, is US $2,046,571 below the value in the business plan.

RECOMMENDATION

71. The Executive Committee may wish to consider:

(a) Approving the project proposal for the conversion of commercial refrigeration appliances manufacturing at Rockwell Industries Limited from the use of HFC-134a to propane (R-290) as the refrigerant, in the amount of US $423,765, plus agency support costs of US $29,664 for UNDP, on the understanding:

(i) That 31,328 CO_2-eq tonnes (21.91 mt) of HFC-134a would be deducted from the starting point for sustained aggregate reductions in HFC consumption once it had been established, and that this deduction would be undertaken in accordance with the methodology agreed under the HFC cost guidelines currently under discussion;

(ii) That the present project would be integrated into stage I of the Kigali HFC implementation plan (KIP) for India, once the plan had been fully formulated for submission for consideration by the Executive Committee; and

(iii) That the level of costs approved would not constitute a precedent for future HFC individual investment project proposals.

CONVERSION OF THE MANUFACTURING OF COMMERCIAL REFRIGERATION APPLIANCES AT ROCKWELL INDUSTRIES LIMITED FROM HFC-134A TO PROPANE (R-290)

PROJECT DESCRIPTION

Background

72. On behalf of the Government of India, UNDP has submitted a proposal for a project to convert the manufacturing of commercial refrigeration appliances at Rockwell Industries Limited (Rockwell), Hyderabad, from the use of HFC-134a to propane (R-290) as a refrigerant, at a total cost of US $1,385,201, plus agency support costs of US $96,964, as originally submitted. This project is described in paragraphs 47 to 70 of the present document.

73. The funding requested in the investment project proposal includes an amount of US $172,500, plus agency support costs of US $12,075 for an energy efficiency pilot project to be implemented at the enterprise, submitted in line with decision 91/65.

Energy efficiency project

Project objective

74. The project aims to maximize the climate benefits from the conversion of the manufacturing lines at Rockwell by jointly implementing a technical assistance project to enhance the energy efficiency of the converted equipment by *inter alia* purchasing high-efficiency components and improving the equipment design. In addition, product certification by an accredited laboratory to a stated performance will enable assessing the improvement in energy efficiency and product market placement and enable consumers to make informed choices.

Project description

75. The pilot project will further optimize the design of 15 models' prototypes through the procurement of highly efficient compressors, condensers, and electrical components, and through design and testing. The units of each model prototyped will take into consideration the potential incremental energy efficiency modifications in the cabinet and the refrigeration system components.

76. The project will carry out performance testing of commercial refrigeration units in an accredited laboratory and conduct product certification for energy efficiency standards. Prototyped units will be deployed in the field for trials to assess the performance in actual operating conditions for at least six months. The final report will include a complete cost analysis to assess the sustainability of the product in the market with respect to capital and operating expenditures.

77. India had not mobilized funding from sources other than the Multilateral Fund for maintaining or enhancing energy efficiency when phasing down HFCs. Accordingly, the project would not result in the duplication of activities or funding.

Project costs

78. The funding request of US $175,000 will cover the incremental capital costs (ICCs) as listed in table 1.

Table 1. ICCs proposed for the energy efficiency pilot component at Rockwell

ICC Line	Unit Cost (US $)	Qty	Total Cost (US $)
Technical assistance for product optimization activities	30,000	1	30,000
EE optimized design and creation of product prototypes	2,500	15	37,500
Prototypes testing	4,000	15	60,000
Prototypes certification	2,000	15	30,000
Data logging system (long term monitoring)	500	15	7,500
Independent peer reviewer	7,500	1	7,500
Total			**172,500**

SECRETARIAT'S COMMENTS AND RECOMMENDATION

COMMENTS

79. In line with decision 91/65, the Government of India confirmed that it did not intend to explore funding from other sources for the pilot energy efficiency project. India, through its Bureau of Energy Efficiency (BEE), has established minimum energy performance standards (MEPS) and an energy labelling mechanism to monitor and assess energy efficiency implementation. Mandatory standards and labelling are for (a) household and similar refrigerating appliances; (b) room-air conditioners (window and split types, fixed and variable speeds) and (c) room air conditioners. BEE has also launched voluntary standards for (a) light commercial AC (from 10.5 kW to 18 kW) (b) chillers and (c) deep freezers (i.e. chest/vertical freezers with rigid or glass doors). These standards will cover the products manufactured by the enterprise, and which aims to assist consumers in making informed decision when selecting appliances on the basis of energy savings that would result based on each appliance's performance. UNDP further noted that the Government is considering transforming those standards into mandatory MEPS for the self-contained commercial refrigeration equipment manufactured by Rockwell (i.e., deep freezer, reach in freezers and glass door displays); however, a timeline for establishing those MEPS is yet not available.

Technical and cost issues

80. In providing more detail on the way the project will be implemented and the energy efficiency gains to be expected UNDP explained the following steps planned:

(a) Departing from R-290-based units resulting from the "standard conversion" (i.e., using fixed speed compressors and the same fin and press heat exchanger technology), external associated experts will support the enterprise to create new optimized designs and build prototypes for testing. At least 15 units will be prototyped following safety and energy efficiency standards for real-life application and using different configurations;

(b) The units of each model prototyped will take into consideration the potential incremental energy efficiency modifications in the cabinet and the refrigeration system components including the adoption of efficient electric components, energy-efficient compressors including inverter compressors, and potentially micro-channel heat exchangers;

(c) An accredited independent laboratory will conduct performance testing of the commercial refrigeration units prototyped; and

(d) Prototyped units will be deployed to the field for trials and performance assessment in actual operating conditions for at least 6 months to also consider seasonal parameters.

81. UNDP also clarified that it would not be feasible to provide an exact assessment of the improvement in energy efficiency that will result from the implementation of the project until some of the steps included in the project, such as selection of specific components, and development of designs in line with those components, had been undertaken. However, based on experiences in previous projects funded by the Clean Cooling Collaborative and references provided by the Refrigeration Technical Options Committee (RTOC), UNDP considered that the energy efficiency of the converted units, after implementation of the pilot project, could be between 5 to 25 per cent higher than the baseline HFC-134a units. In addition, the final report will include detailed information comparing the energy efficiency of the R-290-based units with the baseline HFC-134a-based units.

82. In line with decision 91/65(b)(iv)e, the date of completion of the project will be set as no more than 36 months after the date of approval by the Executive Committee and a detailed project report will be submitted to the Executive Committee within six months of the date of completion of the project and after peer review by an independent expert/agency. The improvements achieved will be shared with other Article 5 countries, noting that certain specific data may be proprietary information of the enterprise and will not be shared.

Proposed and revised costs

83. The Secretariat and UNDP discussed in detail the proposed costs in conjunction with the review of the incremental cost required for the change of refrigerant from HFC-134a to R-290. Specifically, taking into consideration that the work associated with the design of the new units, and creation and certification of prototypes are shared with the technical assistance and production trails and testing included in the ICCs of the conversion, minor adjustments were made to the cost and the total budget was agreed at US $150,000, as shown in Table 2.

Table 2. Proposed and agreed additional cost for the energy efficiency pilot component at Rockwell

ICC Line	Proposed cost (US $)	Agreed cost (US $)
Technical assistance for product optimization activities	30,000	30,000
EE optimized design and creation of product prototypes	37,500	22,500
Prototypes testing	60,000	60,000
Prototypes certification	30,000	22,500
Data logging system (long term monitoring)	7,500	7,500
Independent peer reviewer	7,500	7,500
Subtotal energy efficiency component cost	**172,500**	**150,000**

RECOMMENDATION

84. The Executive Committee may wish to consider:

(a) Approving the project proposal for the energy efficiency pilot component included as part of the conversion project in the manufacturing of commercial refrigeration appliances at Rockwell Industries Limited from the use of HFC-134a to propane (R-290) as the refrigerant, in the amount of US $150,000, plus agency support costs of US $13,500 for UNDP, on the understanding:

(i) That the pilot component will be completed no more than 36 months after the date of approval by the Executive Committee;

(ii) That a detailed project report will be submitted to the Executive Committee within six months of the date of completion of the investment project; and

(iii) That data verified by an independent peer reviewer will be shared with other enterprises and made available to Article 5 countries, except for certain specific proprietary information of the enterprise.

PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT

India

PROJECT TITLE	BILATERAL/IMPLEMENTING AGENCY
(a) Design and development on a pilot scale energy-efficient rotary compressors along with microchannel heat exchangers compatible with R-290 technology at Godrej & Boyce Mfg. Ltd. (Godrej), for use in manufacturing of room air conditioners	Germany

PROJECT OBJECTIVE

1. Redesign an energy-efficient R-290 compressor for five air-conditioning models for pilot production;
2. Redesign/development of microchannel heat exchangers to optimize energy efficiency in resulting air-conditioning products; and
3. Component integration and optimization of R-290 room air conditioners including performance and energy efficiency testing.

NATIONAL CO-ORDINATING AGENCY	Ministry of Environment, Forest, and Climate Change

LATEST ARTICLE 7 DATA (Annex F)	**Year:** 2022	43,354.71 mt	57,219,531 CO_2-eq tonnes

Particular	Godrej	
	Units	**HFC-32**
HFC used by Godrej:	mt in 2022	179.58
	CO_2-eq tonnes in 2022	121,217
HFC to be phased-out:*	mt	650.00
	CO_2-eq tonnes	438,750
HFC alternatives to be phased in:	**Units**	**R-290**
	mt	303.33
	CO_2-eq tonnes	910
Project duration (months):		24
Initial amount requested (US $):		2,310,560
Final project costs (US $):		
Capital cost:		1,853,795
Contingency (10%):		Not requested
Operating cost:		Not requested
Total project cost:		1,853,795
Local ownership (%):		100
Export component (%):		N/A
Requested grant (US $):		1,853,795
Implementing agency support cost (US $):		213,918
Total cost of project to Multilateral Fund (US $):		2,067,713
Energy efficiency savings (US $/kWh):		0.023[8]
Status of counterpart funding (Y/N):		Y
Project monitoring milestones included (Y/N):		Y
Minimum energy performance standards available for the relevant sector (Y/N):		Y
SECRETARIAT'S RECOMMENDATION		For individual consideration

* Based on estimated consumption reduction when the project is completed.

[8] Estimated assuming 2,500 hours of operations of equipment produced in 2022-2023. This is estimated assuming operation of these compressors in the air-conditioning equipment.

PROJECT DESCRIPTION

Background

85. On behalf of the Government of India, the Government of Germany has submitted, in line with decision 91/65, a request for a pilot project to design and develop on a pilot scale energy-efficient rotary compressors along with microchannel heat exchangers compatible with R-290 technology at Godrej & Boyce Mfg. Ltd. (Godrej), for use in manufacturing of room air conditioners (ACs) in India in the amount of US $2,310,560, plus agency support cost of US $264,162, as originally submitted.[9]

Status of implementation of energy efficiency-related activities funded by the Multilateral Fund

86. At the 88th meeting, India received funding for the implementation of enabling activities for HFC phase down (US $250,000), which were to be completed by December 2023; activities are still ongoing and a request for an extension of the project has been submitted to the 93rd meeting.[10] The approved activities included workshops for stakeholders and the general public on the safe-handling of ODS alternatives and energy-efficient/climate-friendly refrigerant options and sectoral technical workshops on the principles for suitable HFC quota allocation and the improvement of the energy efficiency in cooling equipment.

87. At the 92nd meeting the Executive Committee approved funding for the preparation of this project (US $30,000, plus agency support costs), to provide technical assistance for the development of the project.

HFC consumption in India

88. Table 1 presents a summary of HFC consumption for 2022 reported by the Government of India under Article 7 of the Montreal Protocol.

Table 1. HFC consumption in India in 2022 (Article 7)

Chemical	GWP	Total consumption (mt)	Total consumption (CO_2-eq tonnes)
HFC-32	675	16,193.50	10,930,610
HFC-125	3,500	4,002.06	14,007,214
HFC-134a	1,430	17,740.47	25,368,871
HFC-152a	124	2,935.51	364,003
HFC-227ea	3,220	263.56	848,657
HFC-236fa	9,810	72.43	710,528
HFC-245fa	1,030	1,064.84	1,096,784
HFC-365mfc	794	38.40	30,490
HFC-43-10mee	1,640	0.60	984
R-404A	3,922	1,038.27	4,071,664
R-407C	1,774	444.55	788,563
R-410A	2,088	-740.05	(1,544,848)
R-407F	1,825	1.45	2,649
R-426A	1,508	20.00	30,168
R-438A	2,264	200.00	452,887
R-454B	465	0.18	82
R-454C	145	0.07	11
R-455A	145	0.80	116
R-467A	1,359	-37.80	(51,363)
R-513A	629	0.68	430

[9] As per the letter of 15 September 2022 from the Ministry of Environment, Forest, and Climate Change of India Ministry to the Government of Germany.
[10] UNEP/OzL.Pro/ExCom/93/20

Chemical	GWP	Total consumption (mt)	Total consumption (CO_2-eq tonnes)
Custom mix (HFC-365mfc=93%, HFC-227ea= 7%)	964	115.20	111,032
TOTAL	**n/a**	**43,354.71**	**57,219,531**

89. The consumption of HFCs in India is expected to grow in future due to increased demand for residential and commercial ACs and mobile ACs, for both manufacturing and servicing. The consumption of R-410A in the manufacturing of ACs is decreasing due to the increased use of HFC-32 by AC manufacturers, but the overall HFC consumption in servicing is expected to continue because of servicing needs. India is one of the few countries where R-290-based ACs are in use; however, the population of R-290 equipment is low compared to equipment using other refrigerants (i.e., HFCs and HFC blends).

Policy, regulatory and institutional framework

90. The Government of India ratified the Kigali Amendment on 27 September 2021 and has established a licensing system for HFCs since March 2022. Since then, the import/export of HFCs and HFC blends requires a license, to be issued by the Directorate General of Foreign Trade (DGFT) in the Ministry of Commerce and Industry, based on the recommendations of the Ozone Cell in the Ministry of Environment, Forest, and Climate Change (MEFCC). The country has not yet received project preparation funding for the development of a Kigali HFC implementation plan (KIP) but is currently developing a national strategy for HFC phase-down which is expected to be completed by the end of 2023; a request for the preparation of a KIP is expected soon thereafter. The HFC baseline has not yet been established for the country.[11]

91. The energy efficiency of room ACs is governed by the Indian Bureau of Energy Efficiency (BEE). Minimum efficiency levels are prescribed and assigned a star-rating; the sale of ACs with less than a 2-star rating is prohibited. Every two years, the seasonal energy efficiency rating (SEER) level for the star ratings is elevated; in this way, there is continuous improvement in the energy efficiency of air-conditioning products and elimination from the market of products that are less efficient.

Domestic AC manufacturing sector

92. Overall, there are 39 manufacturers of room air-conditioning products in India and Godrej is one of the largest producers. In India, 95 per cent of the room air-conditioning equipment is manufactured domestically, while the remaining 5 per cent is imported from Thailand and Malaysia. The Indian market for split-room ACs is projected to grow at the rate of 10-15 per cent per year according to estimates from the India Cooling Action Plan (ICAP).[12] Demand for refrigeration and air-conditioning (RAC) products in India is increasing due to high economic growth; through the implementation of policies to promote energy-efficient equipment, sales of energy-efficient RAC products are expected to increase in India.

93. About 4 million room air-conditioning compressors are manufactured in India and imports make up the remainder of the demand which accounts for around 6 to 6.5 million per year. None of the current domestic manufacturers of compressors includes those for use in R-290 ACs; these are currently imported.

Enterprise information

94. Godrej is one of the largest AC producers in India. It is 100 per cent nationally owned and the appliance division manufacturing ACs has been in operation since 1958. It has its own research and development (R&D) facility for product design and development. Godrej had successfully started

[11] As a country belonging to Group 2 under the Kigali Amendment, the baseline for India will be established based on the average HFC consumption in 2024-2026 plus 65 per cent of its HCFC baseline.

[12] Press release from the Ministry of Environment, Forest, and Climate Change of India, 14 March 2022 https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1805795

manufacturing R-290 ACs in 2012 with most of the components sourced locally or manufactured in-house except for compressors which are imported.

95. In the early years of R-290 production, Godrej manufactured around 50-80,000 units per year. Over time, other national and foreign manufacturers started producing split-room ACs using HFC-32 as a refrigerant. Due to economies of scale, the cost of HFC-32 compressors became more competitive than R 290 compressors. While Godrej continued to manufacture smaller quantities of R-290 ACs, due to commercial reasons, the enterprise also started producing air-conditioning equipment using HFC-32. As R-290 ACs had a high energy efficiency rating (4-5 star), they catered to a smaller niche market in India.

96. Table 2 provides the production from 2020-2021 to 2022-2023 for Godrej for HFC-32 and R-290 equipment.

Table 2 Production of HFC-32 and R-290-based ACs from 1 ton of refrigeration (TR) to 2.0 TR capacity at Godrej

Refrigerant	Capacity	Production year			Total
		2020-2021	2021-2022	2022-2023	
R-290	1.0 TR		8,436	1,032	9,468
	1.5 TR	22,193	42,577	155	64,925
	2.0 TR		2	540	542
	Subtotal	*22,193*	*51,015*	1,727	*74,935*
HFC-32	1.0 TR	9,431	21,330	63,205	93,966
	1.4 TR			500	500
	1.5 TR		64,333	176,279	240,612
	1.7 TR			90	90
	2.0 TR			19,068	19,068
	Subtotal	*9,431*	*85,663*	*259,142*	*354,236*
	Total	**31,624**	**136,678**	**260,869**	**429,171**

Project overview and funding request

97. The pilot project is being submitted in line with decision 91/65(b)(i)(a).

Project objective

98. The project aims to design and develop on a pilot scale, energy-efficient rotary compressors along with microchannel heat exchangers compatible to R-290 technology and to optimise system design for the manufacturing of room ACs at Godrej. The successful completion of this pilot project will address the challenge of availability and accessibility of cost effective and highly efficient R-290 compressors and microchannel heat exchangers by advancing domestic manufacturing of these components; this is expected to enhance availability of energy-efficient and low-GWP refrigerant-based ACs in India.

99. The pilot project will contribute towards HFC phase-down as the enterprise has committed to reduce their production of ACs using HFC-32 by up to 70 per cent by 2028. The project impact in terms of CO_2-eq-tonne savings resulting from direct consumption reduction, direct emission reduction, and assuming a reduction of 650 mt of annual HFC-32 consumption reduction at the enterprise, is estimated to be about 437,840 CO_2-eq tonnes.[13]

100. The pilot project is also expected to increase the energy efficiency rating of R-290-based ACs, ranging from 1 TR to 2 TR, from its current 5-star rating to an ISEER[14] of 6.61 by 2028, consistent with

[13] This is estimated based on HFC-32 GWP of 675 and R-290 GWP of 6. Indirect emissions based on grid emission factors is not included.

[14] Indian seasonal energy efficiency ratio (ISEER)

the improvements in energy efficiency levels required by the BEE. It is estimated that these improvements in energy efficiency will avoid 600,000 CO_2-eq tonnes in emission over the life of the equipment, based on the manufacturing capacity of the enterprise.

Proposed activities

101. There are three main elements in the project, and each element is described below:

(a) *R-290 rotary compressor design and development, and pilot production*: activities would include extensive design and development of new rotary compressors to minimise material costs and to achieve the level of energy efficiency needed to produce high efficiency ACs based on R-290. To this end, testing will be carried out at the R&D facility. Key project milestones include identifying required capacity/benchmarking and formulating technical specifications; building the preliminary prototype based on product design simulations; testing the thermal performance and based on that refining different features for final testing; manufacturing an initial batch of 5,000 compressors for ACs, field trails and finalising the specifications for different models. All compressor models will be designed for variable speed operation.

(b) *Design and development of microchannel heat exchangers*: develop an optimised design of microchannel heat exchangers for the condensers and evaporators. The final optimized specifications will be used by national suppliers to produce microchannel heat exchangers compatible with R-290 compressors. A heat exchanger calorimeter would be purchased to support optimization and an external expert for product design and development would be recruited; design and development would be carried out at the enterprise's R&D facility.

(c) *Component integration and optimisation of room ACs:* the final stage involves integration of the new compressors and optimised microchannel heat exchangers into the new R-290 room air-conditioning products. This will include other features designed to optimise the products and help improve energy efficiency; the resulting products will be tested for its energy efficiency performance using calorimeter testing according to BEE test standards and compared with the most energy-efficient products with the same coefficient of performance (COP) in the market. The target for all four capacity sizes will be to exceed the ISEER of 6.61, based on the new design with the R-290 rotary compressors.

102. Once the design of the R-290 compressor is completed and tested, this will be manufactured on a pilot basis using the enterprise's existing hermetic reciprocating compressor production[15] line retrofitted for this purpose. It is expected that after pilot production and technical validation of performance, full-scale manufacturing of these compressors would be undertaken with funding to be covered by the enterprise.

103. In addition, Godrej has in recent years invested in production lines for finned-tube heat exchanger manufacturing and is thus making both indoor and outdoor units for the split-room ACs, both for higher efficiency R-290 models and models using other refrigerants. These will be the basis for the optimization of the microchannel heat exchanger design that will be compatible with the redesigned R-290 compressors.

104. The project will be implemented between January 2024 and December 2025.

[15] Godrej produces compressors for domestic and other refrigeration equipment

Total cost of the pilot project

105. The total cost for the pilot project to design and develop on a pilot scale energy-efficient rotary compressors along with microchannel heat exchangers compatible to R-290 technology as submitted is summarized in table 3.

Table 3: Estimated costs for the pilot energy efficiency project at Godrej, as submitted

Project component	Specific activities	Godrej (US $)	MLF requested (US $)	Total (US $)
Compressor pilot line	Tooling and manufacturing lines. Plant building and utility used for rotary compressors including external support	6,081,600	1,660,560	7,742,160
Compressor design and development	Compressor calorimeter, external sourcing of components, testing, trials, external support, and certification	477,000	100,000	577,000
Microchannel heat exchanger design and development	Sourced test samples, testing, trials, and external support	60,000	100,000	160,000
AC design and development	Performance testing, safety testing, certification, and external support	200,000	100,000	300,000
General	Management and fees	50,000	350,000	400,000
	Total	**$6,868,600**	**$2,310,560**	**$9,179,160**

SECRETARIAT'S COMMENTS AND RECOMMENDATIONS

COMMENTS

106. The Secretariat has reviewed the project proposal in light of decision 91/65 and the project preparation that was provided for this project at the 92nd meeting including the required commitment from the enterprise Godrej and the Government of India as specified in paragraph 122 of document UNEP/OzL.Pro/ExCom/92/56.

Policy, regulatory and institutional framework

107. The Secretariat sought clarification on the government support that will be provided to promote R 290-based air-conditioning equipment in India, noting that without the specific policy support, the share of these products in the market would continue to be limited to small niche markets. On behalf of the Government of India, the Government of Germany indicated that once the pilot R-290 room air-conditioning compressors have been developed and successfully demonstrated with the expected energy efficiency levels, the demand for the R 290 compressors will automatically increase due to market dynamics especially with the HFC phase-down obligations of the country. The appropriate supporting policies to promote low-GWP refrigerant-based ACs will be considered in consultation with the key stakeholders including the line ministries/departments, as part of the regulations to be framed during the implementation of the KIP.[16]

108. The Government of Germany also explained that since the Government of India, through the BEE, prescribes the continuous improvement in the energy efficiency of air-conditioning products and eliminating products that are less efficient, the availability of these optimized R-290 products at a higher energy efficiency level will support adoption of energy-efficient ACs acceptable to the users.

[16] India is a group II country and is in the process of preparing its KIP.

Technical and cost-related issues

R-290 rotary compressor design and development and pilot production

109. The Secretariat sought confirmation that as a result of the successful implementation of this project, Godrej will set up a manufacturing facility solely for the production of R-290 compressors for air-conditioning products. The Government of Germany informed that this was confirmed by the enterprise; the facility is expected to manufacture close to 1.6 million compressors once the design and the prototype manufacturing is satisfactorily completed; while the R-290 air-conditioning compressors are intended initially for the use of Godrej in the production of R-290 ACs, any decision on supplying these compressors to other original equipment manufacturers (OEMs) locally and for export will be taken once commercial production commences; further, the share of production for domestic use and export would be based on the assessment of demand for these compressors.

110. The Secretariat reviewed the detailed costs for this component with technical advice from a refrigeration expert specializing in energy efficiency of equipment and using criteria in decision 91/65. Following this review, it was noted that there were cost elements proposed that appeared to relate to the creation of a new manufacturing facility which may not be consistent with Fund policies and guidelines. Upon request for clarifications, the Government of Germany, after consultation with the enterprise explained that the cost elements that did not relate to manufacturing but to improving the energy efficiency of the new R-290 compressors included a metrology set-up, roughness tester, coordinates measuring machine (CMM), equator CMM, height master and gauging stations; and the cost for testing set up. The other costs like compressor assembly, dedicated clean room, compressor calorimeter and trials (prototyping), related to prototype development for the energy-efficient R-290 compressors.

Design and development of microchannel heat exchangers

111. On the microchannel heat exchanger redesign, the Secretariat noted that the manufacturing would be outsourced and queried how product design that would result in changes in microchannel heat exchangers for different equipment would be undertaken. The Government of Germany explained that the inhouse team of experts, supported by simulation tools as well as technical support from an external expert where appropriate, would work in close coordination with the microchannel heat exchangers suppliers in order to achieve the intended outputs including the process of optimising the design with R-290 compressors.

112. In responding to the Secretariat's query about the experience of Godrej in the use of microchannel heat exchangers in R-290 equipment, the Government of Germany confirmed that the enterprise had indeed used microchannel heat exchangers in their production of R-290 ACs; this was changed to finned-tube heat exchangers as the quality of microchannel heat exchangers available in the market including the suitability of the alloys used resulted in product returns. It is expected that with this optimized redesign and the improvement in the alloys used, along with the introduction of special surface finishes, the resulting microchannel heat exchangers will perform better with the new R-290 compressors.

113. The Secretariat also noted that the costs requested under this component did not include those elements that would result in optimized microchannel heat exchangers. Following consultations with the Secretariat, the Government of Germany consulted with their technical advisors and made adjustments to the cost components.

Component integration and product optimization

114. With regard to the testing of the resulting products, the Government of Germany reiterated that these will be tested using the BEE standards through accredited third-party laboratories.

Agreed cost of the pilot project

115. Further to the above, it was agreed to reduce the costs for the component for the compressor pilot line and the costs associated with technical support for product design. The total cost of the project was also reduced by the Government of Germany from US $9,179,160 to US $7,548,095 based on the advice of their technical experts after adjusting other cost elements following the discussion with the Secretariat. The final agreed costs for the pilot project are summarized in table 4.

Table 4: Agreed costs for the pilot energy efficiency project at Godrej

Project component	Specific activities	Godrej (US $)	MLF requested (US $)	Total (US $)
Compressor pilot line	Tooling and manufacturing lines. Plant building and utility used for rotary compressors including external support	2,466,900	384,300	2,851,200
Compressor design and development	Compressor calorimeter, external sourcing of components, testing, trials, external support, and certification	2,952,400	934,495	3,886,895
Microchannel heat exchanger design and development	Sourced test samples, testing, trials, and external support	50,000	110,000	160,000
AC design and development	Performance testing, safety testing, certification, and external support	50,000	250,000	300,000
General	Technical support for product design, testing and technical assessments	175,000	175,000	350,000
	Total	**5,694,300**	**1,853,795**	**7,548,095**

Sustainability of the pilot project and assessment of risks

116. The project is expected to result in new and optimized designs for energy-efficient R-290-based compressors for the manufacture of ACs at Godrej, which would support the enterprise's manufacturing capabilities for R-290-based ACs. While the enterprise is currently producing HFC-32-based ACs, given the enterprise's experience in manufacturing and selling R-290-based ACs in the past,[17] their technical and financial commitment to this project (about 73.5 per cent of project cost to be borne by the enterprise) and their and Government's commitment to promoting R-290-based ACs during the implementation of the KIP, the project is expected to result in the availability R-290-based compressors in India facilitating the transition of the RAC manufacturing sector to R-290 technology. The Government of India is currently developing the national strategy for HFC phase-down and during finalisation of the national strategy in consultation with relevant national stakeholders, they would design additional measures to promote R 290 based ACs and other low-GWP technologies. The Government would report on the manufacturing of R 290-based compressors in Godrej as a part of the project reporting under KIP once the KIP is approved.

RECOMMENDATION

117. The Executive Committee may wish to consider:

(a) Approving the pilot project to design and develop on a pilot scale energy-efficient rotary compressors along with microchannel heat exchangers compatible with R-290 technology at Godrej & Boyce Mfg. Ltd. (Godrej), for use in the manufacturing of room air

[17] Godrej was one of the first companies to commercially market R-290-based residential AC in India and exported these to a few other Article 5 country markets.

conditioners in the context of HFC phase-down for India in the amount of US $1,853,795, plus agency support costs of US $213,918, noting:

(i) The commitment of the enterprise Godrej to convert their production of air conditioners from using HFC-32 to R-290 by up to 70 per cent of the HFC-32 production by 2028;

(ii) The expected direct emission reduction of 437,840 CO_2-eq tonnes by 2028;

(iii) The commitment of the Government of India:

a. To design additional policy measures to promote R-290-based air conditioners and other low-GWP technologies during the preparation of stage I of the Kigali HFC implementation plan (KIP);

b. To report on the progress of the manufacturing of R-290-based compressors in Godrej as a part of reporting under stage I of the KIP once approved; and

(iv) That the project would be completed no later than 31 December 2025 and a detailed project report would be submitted to the Executive Committee within six months of the date of completion of the project.